

DIESEL PARTICULATE FILTERS USED IN UNDERGROUND COAL MINES

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1

PARTICULATE FILTRATION THEORY



2

CHOICES FOR DPM REDUCTION

“THERE IS NO SILVER BULLET”

- Maintenance
- Diesel particulate filters (soot traps)
 - Passive
 - Active
- Disposable diesel particulate ‘paper’ filters
- Alternative approaches
- Ventilation

3

MAINTENANCE

- What is proper maintenance?
- 100% buy in from management
- Regular scheduled maintenance
- Proactive emission reduction program
- Never be satisfied with where you are

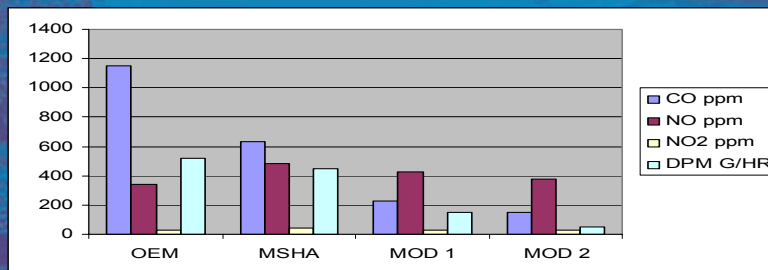
4

HOW BIG OF DIFFERENCE CAN IT MAKE?

- In 1997 CFC's fleet average concentrations of gases in raw exhaust were
 - 1597 ppm carbon monoxide
 - 997 ppm NO_x
- In 2003 CFC's fleet average concentrations of gases in raw exhaust are
 - 158 ppm carbon monoxide
 - 458 ppm NO_x

5

THE EFFECTS OF ENGINE TUNE ON THE EMISSIONS



	OEM	MSHA	MOD 1	MOD 2
CO ppm	1152	632	230	150
NO ppm	340	480	428	380
NO2 ppm	28	45	30	28
DPM G/HR	52	45 ?	14	5.3

6

PASSIVE SOOT TRAP

- The trap should regenerate itself
- The systems needs to be monitored for back pressure
- NO₂ might be a problem
- Relatively low cost

7

PASSIVE SOOT TRAPS



8

PASSIVE SOOT TRAPS

- PIB 02-04 warning about NO₂ production from platinum catalyzed soot traps for both metal/non metal and coal mines
- PIB 02-07 notice for coal only! Traps shall not increase NO₂ emissions

9

ACTIVE SOOT TRAP

- No NO₂ production
- Require space where filters can be regenerated safely
- Need a power supply
- Designed to trap soot during one or more shifts
- Relatively high cost

10

ACTIVE SOOT TRAP ON-BOARD SYSTEM



11

ACTIVE SOOT TRAP OFF-BOARD SYSTEM



12

EVALUATION OF DPF SYSTEMS IN COAL MINES

- Passive systems
 - Cordierite coated with platinum catalyst
 - Excess of NO₂
 - Cordierite coated with base metal catalyst
 - So far more than 100 hours in operation

13

EVALUATION OF DPF SYSTEMS IN COAL MINES

- Active systems
 - Silicon carbide on-board el. regeneration DPF system
 - Insulating filter caused failure of electrical components
 - Redesigned, works well
 - Trouble free 300 hours

14

EVALUATION OF DPF SYSTEMS IN COAL MINES

- Silicon carbide off-board el. regeneration DPF systems
 - DPF accumulate engine pm output during 12 hour shift
 - At the end of shift the unit is replaced with spare one and sent for regeneration
 - Regeneration station is located in maintenance shop
 - Regeneration takes 40 min. to two hours
 - Regeneration schedule should be religiously followed
 - The regeneration process should be supervised by trained personnel
 - This approach is labor intensive and require changing operator's attitude

15

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS

- Heat exchanger
 - Wet (water scrubber and make-up tank)
 - Dry (air-to-water)
- Filter holder + 'paper' filter element
- Water separator (optional)
- Designed for in-by coal vehicles
 - Exhaust temp. Requirements (cooled exhaust)
 - Surface temp. Requirements (water jacketed exhaust manifold)
- High installation cost

16

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS - DRY SYSTEM



17

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS – DRY SYSTEM



18

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS - WET SYSTEM



19

DISPOSABLE DIESEL PARTICULATE 'PAPER' FILTERS

- Advantages
 - Relative simple to replace filter
- Disadvantages
 - Complex and expensive
 - Potential for fire
 - Short filter life
 - Wet system require maintaining water level in scrubber
 - Dry system require frequent heat exchanger cleaning

20

EVALUATION OF DISPOSABLE FILTERS

- Not all media has adequate properties
 - Most of the filters available on market are designed as air intake filters
- Tests showed low efficiency of certain filter media
 - Confusion
 - Use only verified media
- Fire hazard
 - High temperature filters
 - For wet systems
 - For out-by vehicles

21

RETROFITTING DIESEL ENGINES OPERATED ON HIGH ELEVATIONS WITH DPFs

- Naturally aspirated and turbocharged engines should be adjusted for altitude prior to retrofitting them with DPFs
 - DPM and gaseous emissions are significantly affected by altitude
 - DPF system will be overwhelmed by DPM

22

